PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION OF ELECTION

(PCT Rule 61.2)

To:

Assistant Commissioner for Patents
United States Patent and Trademark Office
Box PCT
Washington, D.C.20231
ÉTATS-UNIS D'AMÉRIQUE

in its capacity as elected Office

Date of mailing (day/month/year) 08 December 1999 (08.12.99)	
International application No. PCT/DK99/00239	**Applicant's or agent's file reference** 9249PC/LN/ar
International filing date (day/month/year) 29 April 1999 (29.04.99)	**Priority date** (day/month/year) 01 May 1998 (01.05.98)
Applicant PALLESEN, Bodil, Engberg	

1. The designated Office is hereby notified of its election made:

[X] in the demand filed with the International Preliminary Examining Authority on:

11 November 1999 (11.11.99)

[ ] in a notice effecting later election filed with the International Bureau on:

2. The election [X] was

[ ] was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO **34, chemin des Colombettes** **1211 Geneva 20, Switzerland**	Authorized officer Beate Giffo-Schmitt
Facsimile No.: (41-22) 740.14.35	Telephone No.: (41-22) 338.83.38

PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION OF THE RECORDING OF A CHANGE

(PCT Rule 92bis.1 and Administrative Instructions, Section 422)

To:

PATRADE A/S
Aaboulevarden 21
DK-8000 Aarhus C
DANEMARK

Date of mailing (day/month/year) 08 December 1999 (08.12.99)	
Applicant's or agent's file reference 9249PC/LN/ar	**IMPORTANT NOTIFICATION**
International application No. PCT/DK99/00239	**International filing date** (day/month/year) 29 April 1999 (29.04.99)

1. The following indications appeared on record concerning:

☐ the applicant ☐ the inventor ☒ the agent ☐ the common representative

Name and Address	State of Nationality	State of Residence
PATRADE A/S Store Torv 1 DK-8000 Aarhus C Denmark		
	Telephone No. +45 8730 3700	
	Facsimile No. +45 8730 3701	
	Teleprinter No.	

2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning:

☐ the person ☐ the name ☒ the address ☐ the nationality ☐ the residence

Name and Address	State of Nationality	State of Residence
PATRADE A/S Aaboulevarden 21 DK-8000 Aarhus C Denmark		
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	Facsimile No. +45 7020 3771	
	Teleprinter No.	

3. Further observations, if necessary:
The new address of the agent in the demand has been considered as a request for change under Rule 92bis. In case of disagreement, the applicant should immediately notify the International Bureau accordingly.

4. A copy of this notification has been sent to:

☒ the receiving Office
☐ the International Searching Authority
☒ the International Preliminary Examining Authority
☐ the designated Offices concerned
☒ the elected Offices concerned
☐ other:

The International Bureau of WIPO **34, chemin des Colombettes** **1211 Geneva 20, Switzerland**	Authorized officer Beate Giffo-Schmitt
Facsimile No.: (41-22) 740.14.35	Telephone No.: (41-22) 338.83.38

09/423525
36 US

PATENT COOPERATION TREATY

1771

PCT

From the INTERNATIONAL BUREAU

To:

PATRADE A/S
Aaboulevarden 21
DK-8000 Aarhus C
DANEMARK

NOTIFICATION OF THE RECORDING OF A CHANGE

(PCT Rule 92bis.1 and Administrative Instructions, Section 422)

Date of mailing (day/month/year) 06 November 2000 (06.11.00)	
Applicant's or agent's file reference 9249PC/LN/ar	**IMPORTANT NOTIFICATION**
International application No. PCT/DK99/00239	**International filing date** (day/month/year) 29 April 1999 (29.04.99)

1. The following indications appeared on record concerning:

[X] the applicant [ ] the inventor [ ] the agent [ ] the common representative

Name and Address	State of Nationality	State of Residence
ERIKSEN, Marianne Dr. Margrethesvej 4B, 1 DK-8200 Aarhus N Denmark	DK	DK
	Telephone No.	
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2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning:

[ ] the person [X] the name [X] the address [ ] the nationality [ ] the residence

Name and Address	State of Nationality	State of Residence
ERIKSEN, Marianne, Etlar Lillerupvej 64 DK-8410 Rønde Denmark	DK	DK
	Telephone No.	
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	Teleprinter No.	

3. Further observations, if necessary:

4. A copy of this notification has been sent to:

[X] the receiving Office
[ ] the International Searching Authority
[ ] the International Preliminary Examining Authority
[ ] the designated Offices concerned
[X] the elected Offices concerned
[ ] other:

The International Bureau of WIPO **34, chemin des Colombettes** **1211 Geneva 20, Switzerland**	Authorized officer Aino Metcalfe
Facsimile No.: (41-22) 740.14.35	Telephone No.: (41-22) 338.83.38

(1771)

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PATENT COOPERATION TREATY

PCT

REC'D 0 2 JUN 2000

WIPO PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT 17X1

(PCT Article 36 and Rule 70) 09/423525

Applicant's or agent's file reference	FOR FURTHER ACTION	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
9249PC/LN/ar		
International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/DK99/00239	29/04/1999	01/05/1998
International Patent Classification (IPC) or national classification and IPC D04H1/42		
Applicant ERIKSEN MARIANNE et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 6 sheets, including this cover sheet.

   ☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of 8 sheets.

3. This report contains indications relating to the following items:

   - I ☒ Basis of the report
   - II ☐ Priority
   - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - IV ☐ Lack of unity of invention
   - V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations suporting such statement
   - VI ☐ Certain documents cited
   - VII ☒ Certain defects in the international application
   - VIII ☒ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
11/11/1999	30.05.00
Name and mailing address of the international preliminary examining authority: European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer Martinez, C Telephone No. +49 89 2399 7510

Form PCT/IPEA/409 (cover sheet) (January 1994)

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/DK99/00239

I. Basis of th report

1. This report has been drawn on the basis of (*substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments.*):

Description, pages:

2,5,8-16	as originally filed			
1,1A,3,4,6,7	as received on	13/05/2000	with letter of	10/05/2000

Claims, No.:

7-11	as originally filed			
1-6	as received on	13/05/2000	with letter of	10/05/2000

2. The amendments have resulted in the cancellation of:

☐ the description, pages:
☐ the claims, Nos.:
☐ the drawings, sheets:

3. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

4. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims 1-11
	No:	Claims
Inventive step (IS)	Yes:	Claims 1-11
	No:	Claims
Industrial applicability (IA)	Yes:	Claims 1-11
	No:	Claims

2. Citations and explanations

see separate sheet

VII. Certain defects in the international application

The following defects in the form or contents of the international application have been noted:

see separate sheet

VIII. Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

see separate sheet

Reference is made to the following documents:
D1: WO-A-9633306
D2: DE-A-4416805
D3: WO-A-9108332
D5: WO-A-9801611, cited on page 3, line 18.

Re Item V

1. Novelty - Inventive step

The subject-matter of Claims 1 to 11 appears to be new and inventive in the sense of Articles 33(2) and (3) PCT, the reasons being as follows:

Claims 1 to 9

Document D1 (cited as an X document), which is considered to represent the most relevant state of the art, discloses the following features of Claim 1:

- a method for manufacturing a fibre mat using vegetable fibres (D1: Herstellung eines Vlieses aus Pflanzenfasern);
- where the mat is formed by a dry forming process, whereby the fibres are randomly oriented (D1: p.7, l.13-15);
- where the plants are harvested by cutting followed up by threshing, where plant stems are retted wholly or partially (D1: p.3, l.36-37);
- where drying is performed for providing a desired water content (D1: p7, l.8);
- where the mat is fixed (D1: p.7, l.18-20).

The subject-matter of Claim 1 differs only from document D1 in that:
the fibres are shortened and separated for establishing a fibre mass comprising mainly single fibres with lengths withing the desired interval between 0.1 and 30 mm.

Therefore, the subject-matter of Claim 1, and therefore Claims 2 to 9, appears to be new.

According to the description (see p4, l.13-22), the technical effects obtained by shortening and separating the fibers are the fibrillation of the fibres and the obtention of single fibres with a minimum of shives. Due to this fibrillation, inter-fibre bonds are established in the form of fibre-to-fibre bonds between the single fibres, and consequently the formed mat does not need to be needled and the dry-forming process

can take place without steam bonding of the fibres and without the use of a binder (see p.4, l.18-24).
In document D1, the fibres are relatively long (up to 15 cm, see D1: p7, l.9) and thermoplastic fibres are used in order to assure the bonding of the fibres in the nonwoven (D1: p4, l.12-19 + p7, l.10-12). Document D1 teaches therefore away the possibility of shortening and separating the fibres in order to cause their fibrillation and create fibre-to-fibre bonds during the formation of a fibre mat.

Document D2 discloses a process in which the separation of the fibres from the wooden parts (shives) is achieved mechanically (D2: col.1, l.1-5) and in which flax fibres are cut at a length between 2 and 12 mm, preferably between 4 and 8 mm (D2: col.1, l.29-40). Nevertheless, this process is not intended to cause the fibrillation of the fibres in order to create fibre-to-fibre bonds during the formation of a fibre mat.

Document D3 discloses a plate of flax fibre felt manufactured by **needle bonding** a carded mat of **long fibres** (5 to 15 cm).

Document D5 (cited as an X document) does not suggest any subprocess where the fibres are shortened and separated as in the present invention. Moreover, a bond fibre, which is a synthetic plastic material such as thermoplastic fibres, is added to the fibres before the formation of the web (D5: p.6, l.14-19).

Hence, the subject-matter of Claim 1, and therefore of Claims 2 to 9, appears to involve an inventive step.

Claims 10 and 11
The method according to Claim 1 being new and inventive, the fibre mat manufactured according to this method as claimed in claim 10 and its use as claimed in Claim 11 also appear to be new and inventive.

2. Industrial applicability
The subject-matter of Claims 1 to 11 appears to be industrial applicable in the sense of Article 33(4) PCT.

Re Item VII

According to Rule 5.1(a)(ii) PCT, the closest prior art document D1 should be mentioned in the description and briefly discussed.

Re Item VIII

The present application does not meet the requirements of Article 6 PCT, because the subject-matter of the following claims is not clear.

Claim 1

The way Claim 1 is worded, it is not clear which steps are part of the pre-treatment of the fibres. According to the description, it seems that cutting and threshing (see p5, l.4-8) as well as shortening and separation of the fibers (see p5, l.21) are all part of the pre-treatment of the fibers.

The disclosure "as inter-fibre bonds ..... fibrillated" is the result of a scutching step (see p4, l.18-22 + p5, l.29-32), which step should be mentioned in the claim since it is essential to cause the fibrillation of the fibres.

Claim 10

It is not clear what is meant by "the character of a nonwoven".

Claim 3

The adjective "possible" is too vague.

METHOD FOR MANUFACTURING A FIBRE MAT, FIBRE MAT AND USE OF SUCH FIBRE MAT

Background of the invention

The present invention concerns a method for manufacturing a fibre mat using vegetable fibres, where the fibres are pre-treated, and where the mat is formed by a dry forming process, whereby the fibres are randomly oriented. More specific, the invention concerns a use of flax fibres and hemp fibres for manufacturing fibre mats which are made by using fibres which are shortened and separated and which afterwards are used for manufacturing the fibre mat. The plant fibres are used as substitute for mineral wool fibres, wooden fibres, wooden cellulose, synthetic fibres etc.

Furthermore, the invention concerns a fibre mat manufactured by the method according to the invention, as well as the invention also concerns a use of such a fibre mat.

It is known to use plant fibres by the making of fibre mats. Such were formed by carding the fibres. Thereafter a fur is formed and finally a needling is performed for making the finished fibre mat. Such a method is connected with several drawbacks. It has thus been necessary to have a precise degree of humidity in the flax out of consideration to the pliability in order to perform the needling process. However, a necessary dry condition will result in decomposition of flax fibres and thereby cause dust formation and formation of short fibres which very easily could be torn out of the formed fibre mat. It has thus been an expensive process, and at the same time there has been a risk of dust formation from the formed fibre mat.

The manufacture of the known carded fibre mats will cause that the fibres are lying in separate piles so that there is no strong bonds between the single layers in the fibre mat. Furthermore, there is used relatively long fibres, which typically will be between 100 - 150 mm, but may be up to 200 mm. Fibre mats of flax and hemp are made traditionally from tow which is a by-product when making long fibres for carding and spinning. This takes place at flax scutching mills. The process is expensive and diffi-

cult and therefore tow together with long textile fibres from plant fibres, such as flax and hemp, are relatively expensive. Furthermore, the known technique has great re-

By a slight retting and subsequent mechanical and possible chemical treatment it is possible to decompose the fibre bundles and form single fibres. The single fibres may be used performing more airy products than is the case when making products from fibre bundles. However, it has been stated that the formed single cell fibres are not suitable for making fibre mats by the known needle processes because of the shortening into lengths making them unsuitable for carding.

By the present invention there is focused especially on flax fibres and hemp fibres, but the invention may also be used in connection with other plant fibres with a structure corresponding to the one known from flax and hemp plants.

There is a wish of a new method whereby plant fibres, preferably flax fibres and hemp fibres, may be utilised for making fibre mats, which is not connected with the drawbacks of known carded or needled fibre mats, and which also may be used industrially in a long series of products.

A method in which the carding and needle process has been left out has thus been proposed previously. From WO 98/01611 there is thus known a method for making a fibre product where the fibres are pre-treated with the combination of retting and mechanical decomposition. The formed fibres are afterwards formed to the final product by a dry forming process. However, there is no specific indication of subprocesses for providing fibres with the properties which are desirable in the final product. Furthermore, the described method is based on the use of relatively long fibres which may have a length corresponding to the fibres from a carding process. Such long fibres may cause difficulties in the process steps forming a part of the method. Furthermore, there is no direction for harvesting the fibres in an effective way on a suitable process step under consideration of the subsequent treatment.

It is thus an object of the invention to indicate a method for manufacturing a new kind of fibre mat and to indicate subprocesses which are advantageous at the providing of the fibres with a quality being suitable in the process and which results in final prod-

ucts with the desired properties. It is furthermore an object to indicate a fibre mat which is made by the method and to indicate a specific use of such a fibre mat.

The object of the invention is achieved by a method mentioned by way of introduction, which method is characterised in the steps where the plants are harvested by cutting followed up by threshing, where plant stems are retted wholly or partially and is then dried for providing a desired water content and thereafter shortened and separated for establishing a fibre mass comprising mainly single fibres with lengths within the desired interval between 0.1 and 30 mm, and where the mat is fixed, as inter-fibre bonds at least partially are established between the single fibres as these are more or less fibrillated.

With this method there is thus established a pre-treatment, where the fibres are shortened and separated for forming a fibre mass mainly containing single fibres with lengths within the desired interval with a length being so short that they are not suitable for carding. A shortening may be performed arbitrarily in suitable equipment, as the subsequent process do not require carding and thereby do not necessitate a certain length of the fibres. By the shortening, a fibrillation takes place which causes that the single fibres at the subsequent dry-forming process may form a sheet which is cohesive without need of a binder, as fibre bundles mesh with each other. Thus there is established inter-fibre bonds in the form of fibre-to-fibre bonds between the single fibres. The formed mat do not need to be needled and the dry-forming process also takes place without steam bonding of the fibres. We are thus speaking of a very simple procedure for forming the fibre mat. The formed fibre mat is airy and voluminous and may be compacted to the desired degree, depending on the intended use. It will also be possible to add binder in a greater or lesser amount depending on the desired use of the finished product.

Traditional harvesting of flax and hemp for textile production takes place by pulling which is a slow and work intensive process. After the pulling where all of the plant is pulled up, it is laid aside for retting. Subsequently the stems are pressed into bales and driven to fibre factory. The seeds are torn off in a scutching mill and the straws are

exposure is completely different from the traditional scutching where very long plant fibres are produced for carding and spinning.

The cleaning of shives from fibres may take place with a rotating riddle or the like. In practice it is difficult to clean the fibres completely from shives and fibre dust. However, it will be possible to have a lesser part remaining in the fibre mass without this reducing the quality of the formed fibre mat. Thus, to a certain extent, shives may be used at the subsequent manufacture of the fibre mat.

For some fibre mats where use of pulping of the plant fibres is desired, for example for fibre absorbent, there is performed a further pre-treatment of the fibres before the forming of the fibre mat. Pulping may be performed as the fibres are boiled in water under pressure or boiled in an extruder. Furthermore, they may be treated chemically, for example by adding a base to the water. Thereafter the formed fibres are washed and dried before they subsequently are used for dry-forming. Alternatively, there may also be performed a wet cleaning of the fibre mass in this manufacturing step. Thus the fibres which are cleaned through a riddle and pulped, may be fed to a hydrocyclone, whereby it has appeared to be possible by cleaning to remove a very large part of the shives in the finished pulp. It has thus appeared possible to make a pulp which only has a content of up to 0.1 % shives. As the shives are removed, the strength is increased in the subsequently formed fibre mat, as the fibre mat will contain more fibres for fibre bonds, as the fibre mat contains more fibres per area unit, because the weight of one shive corresponds to the weight of a large number of fibres. In practice it has appeared possible to increase the strength in the finished product by cleaning off shives in a hydrocyclone. Because the capacity in the hydrocyclone is low, it is advantageous to clean off as many shives as possible by the dry process. The subsequent treatment/cleaning in a hydrocyclone will thus preferably take place in connection with methods where the pre-treatment of the fibres comprises a pulping.

The formed fibres are then used for forming the fibre mat by a dry-forming process which substantially corresponds to a dry-forming process used in the dry-forming of paper.

The formed single fibres will be more or less fibrillated which increases the tendency of the fibres being able to wind and roll into each other. Thus there is automatically achieved inter-fibre bonds in the fibre mat. For some application areas it will thus not be necessary to add binders. However, it will also be possible to add binders in order to form inter-fibre bonds between the single fibres. The appearing fibre mat will thus have a homogenous cohesive structure through the whole thickness.

The binders that can be used may be organic binders, synthetic organic binders, or natural binders. As binders may be used polymers, for example thermoplastic. Especially at the forming of composite products and high strength products where the formed fibre sheet may be said to be a fibre reinforcement situated in a matrix of polymers, there may be used relatively large amounts of the binders. In such products there will thus be used up to 50% binders in relation to the finished product.

The binders may also be provided in the form of synthetic fibres, for example bi-component fibres consisting of polypropylene and polyethylene, polyester, vinyl etc. In such a situation the fixation of the sheet will take place by heating up to the melting temperature of the plastic, whereby inter-fibre bonds are established. As examples of natural binders can be mentioned starch and lactic acid products. Such binders may be added as a part up to 5 -15%.

The amount and type of binders added will thus depend on the intended use of the formed fibre mat. A fibre mat intended for isolation mats will thus contain very little or no binder. Contrary to this, a composite sheet, for example, has properties corresponding to those known from fibre and chip-boards will contain a larger amount of binder (10 - 50%), and binder and fibre mat will go through a compression simultaneously with the establishing of the inter-fibre bonds. Hereby a compact and strong sheet is formed.

Furthermore, it will be possible to vary the properties of the formed product by changing the length of the fibres in the product. Thus for certain products it will be advantageous that a part, for example of 10% or more, of the shives from the separa-

CLAIMS

1. A method for manufacturing a fibre mat using vegetable fibres, where the fibres are pre-treated, and where the mat is formed by a dry forming process, whereby the fibres are randomly oriented, c h a r a c t e r i s e d in the steps where the plants are harvested by cutting followed up by threshing, where plant stems are retted wholly or partially and is then dried for providing a desired water content and thereafter shortened and separated for establishing a fibre mass comprising mainly single fibres with lengths within the desired interval between 0.1 and 30 mm, and where the mat is fixed, as inter-fibre bonds at least partially are established between the single fibres as these are more or less fibrillated.

2. A method according to claim 1, c h a r a c t e r i s e d in that the pre-treatment comprises a shortening of the fibres to a length between 3 and 20 mm and especially between 4 and 15 mm.

3. A method according to claim 1 or 2, c h a r a c t e r i s e d in that the fibres are retted partially on the field and that they afterwards are imparted a possible further controlled retting in water containing enzymes before the shortening.

4. A method according to any preceding claim, c h a r a c t e r i s e d in that the inter-fibre bonds are established by the application of organic binders, synthetic organic binders or natural binders.

5. A method according to any preceding claim, c h a r a c t e r i s e d in that the fibres are selected among flax and hemp.

6. A method according to any preceding claim, c h a r a c t e r i s e d in that the stems are scutched in a hammer mill and shortened to a desired length, that fibres within a desired length interval are separated by use of a rotating riddle, that the fibre fraction

is dry formed into a mat as the fibres are blown into a forming head disposed above a forming wire.

FAXED TO NO.: 43508001 PAGES 29
THE ORIGINAL DOCUMENTS HAVE BEEN FORWARDED SIMULTANEOUSLY

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PCT REQUEST

The undersigned requests that the present international application be processed according to the Patent Cooperation Treaty.

For receiving Office use only

International Application No. PCT/DK 99/00239

International Filing Date 29 APRIL 1999

Name of receiving Office and "PCT International Application": Patentdirektoratet, Danish Patent Office, PCT-International Application

Applicant's or agent's file reference (if desired) (12 characters maximum): 9249PC/LN/ar

Box No. I TITLE OF INVENTION

Method for manufacturing a fibre mat, fibre mat and use of such fibre mat

Box No. II APPLICANT

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

ERIKSEN, Marianne
Dr. Margrethesvej 4B, 1
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Denmark

☐ This person is also inventor.

Telephone No.

Facsimile No.

Teleprinter No.

RECEIVED TC 1700 MAIL ROOM 2000

State *(that is, country)* of nationality: DK

State *(that is, country)* of residence: DK

This person is applicant for the purposes of: ☒ all designated States ☒ all designated States except the United States of America ☐ the United States of America only ☐ the States indicated in the Supplemental Box

Box No. III FURTHER APPLICANT(S) AND/OR (FURTHER) INVENTOR(S)

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

PALLESEN, Bodil Engberg
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DK-8410 Rønde
Denmark

This person is:
☐ applicant only
☒ applicant and inventor
☐ inventor only *(If this check-box is marked, do not fill in below.)*

State *(that is, country)* of nationality: DK

State *(that is, country)* of residence: DK

This person is applicant for the purposes of: ☐ all designated States ☐ all designated States except the United States of America ☒ the United States of America only ☐ the States indicated in the Supplemental Box

☐ Further applicants and/or (further) inventors are indicated on a continuation sheet.

Box No. IV AGENT OR COMMON REPRESENTATIVE; OR ADDRESS FOR CORRESPONDENCE

The person identified below is hereby/has been appointed to act on behalf of the applicant(s) before the competent International Authorities as: ☒ agent ☐ common representative

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)*

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☐ **Address for correspondence:** Mark this check-box where no agent or common representative is/has been appointed and the space above is used instead to indicate a special address to which correspondence should be sent.

Box No.V DESIGNATION OF STATES

The following designations are hereby made under Rule 4.9(a) *(mark the applicable check-boxes; at least one must be marked)*:

Regional Patent

☒ **AP** **ARIPO Patent:** GH Ghana, GM Gambia, KE Kenya, LS Lesotho, MW Malawi, SD Sudan, SZ Swaziland, UG Uganda, ZW Zimbabwe, and any other State which is a Contracting State of the Harare Protocol and of the PCT

☒ **EA** **Eurasian Patent:** AM Armenia, AZ Azerbaijan, BY Belarus, KG Kyrgyzstan, KZ Kazakhstan, MD Republic of Moldova, RU Russian Federation, TJ Tajikistan, TM Turkmenistan, and any other State which is a Contracting State of the Eurasian Patent Convention and of the PCT

☒ **EP** **European Patent:** AT Austria, BE Belgium, CH and LI Switzerland and Liechtenstein, CY Cyprus, DE Germany, DK Denmark, ES Spain, FI Finland, FR France, GB United Kingdom, GR Greece, IE Ireland, IT Italy, LU Luxembourg, MC Monaco, NL Netherlands, PT Portugal, SE Sweden, and any other State which is a Contracting State of the European Patent Convention and of the PCT

☒ **OA** **OAPI Patent:** BF Burkina Faso, BJ Benin, CF Central African Republic, CG Congo, CI Côte d'Ivoire, CM Cameroon, GA Gabon, GN Guinea, GW Guinea-Bissau, ML Mali, MR Mauritania, NE Niger, SN Senegal, TD Chad, TG Togo, and any other State which is a member State of OAPI and a Contracting State of the PCT *(if other kind of protection or treatment desired, specify on dotted line)* .....

National Patent *(if other kind of protection or treatment desired, specify on dotted line)*:

☒	AL	Albania	☒	LS	Lesotho
☒	AM	Armenia	☒	LT	Lithuania
☒	AT	Austria and Utility Model	☒	LU	Luxembourg
☒	AU	Australia	☒	LV	Latvia
☒	AZ	Azerbaijan	☒	MD	Republic of Moldova
☒	BA	Bosnia and Herzegovina	☒	MG	Madagascar
☒	BB	Barbados	☒	MK	The former Yugoslav Republic of Macedonia
☒	BG	Bulgaria			
☒	BR	Brazil	☒	MN	Mongolia
☒	BY	Belarus	☒	MW	Malawi
☒	CA	Canada	☒	MX	Mexico
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☒	CZ	Czech Republic and Utility Model	☒	PT	Portugal
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Check-boxes reserved for designating States (for the purposes of a national patent) which have become party to the PCT after issuance of this sheet:

☒ AE United Arab Emirates

☒ ZA South Africa

☐ .....

Precautionary Designation Statement: In addition to the designations made above, the applicant also makes under Rule 4.9(b) all other designations which would be permitted under the PCT except any designation(s) indicated in the Supplemental Box as being excluded from the scope of this statement. The applicant declares that those additional designations are subject to confirmation and that any designation which is not confirmed before the expiration of 15 months from the priority date is to be regarded as withdrawn by the applicant at the expiration of that time limit. *(Confirmation of a designation consists of the filing of a notice specifying that designation and the payment of the designation and confirmation fees. Confirmation must reach the receiving Office within the 15-month time limit.)*

Box No. VI PRIORITY CLAIM ☐ Further priority claims are indicated in the Supplemental Box.

Filing date of earlier application (day/month/year)	Number of earlier application	Where earlier application is: national application: country	regional application:* regional Office	international application: receiving Office
item (1) 01.05.1998 1st May 1998	(0609/98) PA 1998 00609	DK		
item (2)				
item (3)				

RO/DK

☒ The receiving Office is requested to prepare and transmit to the International Bureau a certified copy of the earlier application(s) *(only if the earlier application was filed with the Office which for the purposes of the present international application is the receiving Office)* identified above as item(s): (1)

* *Where the earlier application is an ARIPO application, it is mandatory to indicate in the Supplemental Box at least one country party to the Paris Convention for the Protection of Industrial Property for which that earlier application was filed (Rule 4.10(b)(ii)). See Supplemental Box.*

Box No. VII INTERNATIONAL SEARCHING AUTHORITY

Choice of International Searching Authority (ISA) *(if two or more International Searching Authorities are competent to carry out the international search, indicate the Authority chosen; the two-letter code may be used):*

ISA / SE

Request to use results of earlier search; reference to that search *(if an earlier search has been carried out by or requested from the International Searching Authority):*

Date *(day/month/year)* Number Country *(or regional Office)*

Box No. VIII CHECK LIST; LANGUAGE OF FILING

This international application contains the following **number of sheets:**

request	:	3
description (excluding sequence listing part)	:	16
claims	:	2
abstract	:	1
drawings	:	
sequence listing part of description	:	
Total number of sheets	:	22

This international application is **accompanied** by the item(s) marked below:

1. ☒ fee calculation sheet
2. ☒ separate signed power of attorney
3. ☐ copy of general power of attorney; reference number, if any:
4. ☐ statement explaining lack of signature
5. ☐ priority document(s) identified in Box No. VI as item(s):
6. ☐ translation of international application into (language):
7. ☐ separate indications concerning deposited microorganism or other biological material
8. ☐ nucleotide and/or amino acid sequence listing in computer readable form
9. ☒ other *(specify)*: Copy of Official Letter/Assignm. of priority rights

Figure of the drawings which should accompany the abstract:

Language of filing of the international application: Danish

Box No. IX SIGNATURE OF APPLICANT OR AGENT

Next to each signature, indicate the name of the person signing and the capacity in which the person signs (if such capacity is not obvious from reading the request).

Patrade A/S
Leif L. Nielsen (patent agent)

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1. Date of actual receipt of the purported international application: RO/DK 29 APRIL 1999 (29.04.99)
2. Drawings: ☐ received: ☐ not received:
3. Corrected date of actual receipt due to later but timely received papers or drawings completing the purported international application:
4. Date of timely receipt of the required corrections under PCT Article 11(2):
5. International Searching Authority (if two or more are competent): ISA /
6. ☐ Transmittal of search copy delayed until search fee is paid.

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Date of receipt of the record copy by the International Bureau: 11 MAY 1999 (11.05.99)

FREMGANGSMÅDE TIL FREMSTILLING AF EN FIBERMÅTTE, FIBERMÅTTE SAMT ANVENDELSE AF EN SÅDAN FIBERMÅTTE.

Opfindelsens baggrund

Den foreliggende opfindelse angår en fremgangsmåde til fremstilling af en fibermåtte under anvendelse af plantefibre. Opfindelsen angår mere specifikt en anvendelse af hørfibre og hampefibre til fremstilling af fibermåtter, som er fremstillet ved anvendelse af fibre, der er afkortet og separeret, og som derefter benyttes til fremstilling af fibermåtten. Plantefibrene anvendes som erstatning af mineraluldsfibre, træfibre, træcellulose, syntetiske fibre m.v.

Opfindelsen angår endvidere en fibermåtte, der er fremstillet ved fremgangsmåden ifølge opfindelsen, ligesom opfindelsen også angår en anvendelse af en sådan fibermåtte.

Det er kendt at anvende plantefibre ved fremstilling af fibermåtter. Sådanne blev dannet ved, at fibrene kartes. Derefter dannes en pels og til slut foretages en nåling for fremstilling af den færdige fibermåtte. En sådan fremgangsmåde er forbundet med flere ulemper. Det har således været nødvendigt at have en præcis fugtighedsgrad i hørene af hensyn til smidigheden for at kunne gennemføre nåleprocessen. Imidlertid vil en nødvendig tør tilstand medføre nedbrydning af hørfibre og dermed anledning til støvdannelse og til dannelse af korte fibre, som meget let kunne udrives af den dannede fibermåtte. Det har således været en dyr proces, og samtidig har der været risiko for støvudvikling fra den dannede fibermåtte.

Fremstillingen af de kendte kartede fibermåtter vil bevirke, at fibrene ligger i adskilte flor, således at der ikke findes en stærk binding mellem de enkelte lag i fibermåtten. Endvidere anvendes der relative lange fibre, som typisk vil være mellem 100 - 150 mm, men kan være op til 200 mm. Fibermåtter af hør og hamp fremstilles traditionelt ud fra blår, der er et biprodukt ved fremstilling af lange fibre til kartning og spinding. Dette foregår på hørskætterier. Processen er dyr og vanskelig, og derfor er blår samt

lange tekstilfibre af plantefibre, så som hør og hamp, relative dyre. Endvidere stiller den kendte teknik store krav til råvarekvalitet, herunder råvarernes rødningsgrad.

Hørplanter kan have en stængel med en længde på mellem 600 og 800 mm. Stænglen har stærke fiberbundter, der forløber fra rod til top. Disse fiberbundter (taver) er anbragt yderst i stænglen, og i mellemrummet mellem fiberbundterne er der en midterstilk, der består af vedceller, som efter fiberfrilægning giver de såkaldte skæver.

Hampplanter har stængler, der er betydeligt længere end hørplantens stængler. De kan have længder op til 2.000 - 3.000 mm. Hampstænglen er principielt opbygget på samme måde som hør med fiberbundter yderst. Inderst findes de træholdige vedceller (skæver), som består af korte fibre med en længde på 0,5 - 0,6 mm (elementarfiberlængde).

For at kunne skille hørfibrene fra veddelene i stænglen må den underkastes en rødning, som er en mikrobiologisk proces. Traditionelt foregår denne på marken ved dugrødning. Ved rødningen nedbrydes hemicellulose og pektin, der sammenbinder fibrene og veddelene. Rødningsgraden er alt afgørende ved fremstillingen af tekstilfibre til kartning og spinding. Således er grænsen mellem en velrødnet og overrødnet fiber meget snæver. Dette er en vanskelig proces at styre, da det vil være en biologisk proces i naturen, der bestemmer kvaliteten.

Ved den foreliggende opfindelse er der ikke samme krav til specifik rødningsgrad. Ved processen ifølge den foreliggende opfindelse, er det således muligt at anvende en traditionel rødning eller en styret rødning, for eksempel i vand tilsat enzymer. Det er således muligt at frilægge og anvende fibre fra helt urødnet til stærkt overrødnet kvalitet afhængig af anvendelsesformål. Det er således muligt at anvende stængler, der er urødnet, der er dugrødnet på marken, eller som er rødnet ved en styret rødning. Efter rødningen og en tørring udsættes hør for mekanisk behandling for at adskille fiberbundterne fra skæverne. De dannede fibre kan afkortes ved overskæring eller klipning for at danne de fiberlængder, som ønskes.

Ved let rødning og efterfølgende mekanisk og eventuelt kemisk behandling er det muligt at nedbryde fiberbundterne og danne enkeltfibre. Enkeltfibrene kan benyttes til dannelse af mere luftige produkter end det er tilfældet ved fremstilling af produkter ud fra fiberbundter. Imidlertid har det været fremført, at de dannede enkeltcelle fibre ikke er egnede til fremstilling af fibermåtter ved de kendte nålingsprocesser på grund af afkortningen til længder, som gør dem uegnede til kartning.

Ved den foreliggende opfindelse er der specielt fokuseret på hørfibre og hampefibre, men opfindelsen vil også kunne anvendes i forbindelse med andre plantefibre med en opbygning svarende til den, der kendes fra hør- og hampeplanter.

Der eksisterer et ønske om en ny metode, hvormed plantefibre, fortrinsvis hørfibre og hampefibre, kan benyttes til fremstilling af fibermåtter, som ikke er forbundet med ulemperne ved kendte kartede og nålede fibermåtter, og som tillige kan anvendes industrielt i en lang række produkter.

Der har således tidligere været foreslået en fremgangsmåde, hvor karte- og nåleprocessen har været udeladt. Fra WO 98/01611 kendes således en fremgangsmåde til fremstilling af et fiberprodukt, hvor fibrene forbehandles ved en kombination af rødning samt mekanisk nedbrydning. De dannede fibre dannes derefter til det endelige produkt ved en tørformningsproces. Der er imidlertid ingen specifik angivelse af delprocesser for tilvejebringelse af fibre med de egenskaber, som er ønskelige i slutproduktet. Endvidere er den beskrevne metode baseret på anvendelse af relative lange fibre, der kan have en længde svarende til fibre fra karteprocessen. Sådanne lange fibre kan give vanskeligheder i de procestrin, som indgår i fremgangsmåden. Endvidere er der ingen anvisning på et egnet metodetrin til høstning af fibrene på en effektiv måde under hensyn til den efterfølgende behandling.

Det er således et formål med opfindelsen at anvise en fremgangsmåde til fremstilling af en ny type fibermåtte samt at anvise delprocesser, som er fordelagtige ved tilvejebringelsen af fibrene med en kvalitet som anvendelige i processen, og som giver slutprodukter de ønskede egenskaber. Det er endvidere et formål at anvise en fibermåtte,

der er fremstillet ved fremgangsmåden samt at anvise en specifik anvendelse af en sådan fibermåtte.

Formålet ifølge opfindelsen opnås med en fremgangsmåde, hvor fibrene forbehandles, idet planterne høstes ved afskæring samt tærskning, hvor plantestængler rødnes helt eller delvis og derefter afkortes og separeres for etablering af en fibermasse omfattende stort set enkeltfibre med længder indenfor det ønskede interval mellem 0,1 og 30 mm, hvor tørring eventuelt foretages for tilvejebringelse af et ønsket vandindhold, hvor fibrene orienteres tilfældigt, idet måtten dannes ved en tørformningsproces, og hvor måtten fikseres, idet interfiberbindinger i det mindste delvis etableres mellem enkeltfibrene, idet disse er mere eller mindre fibrillerede.

Med denne fremgangsmåde er der således etableret en forbehandling, hvor fibrene afkortes og separeres for dannelse af en fibermasse, der indeholder stort set enkeltfibre med længder inden for det ønskede interval med en længde, der er så kort, at de ikke vil være egnet til kartning. Afkortningen kan ske vilkårligt i egnet udstyr, da den efterfølgende proces ikke kræver kartning og dermed ikke nødvendiggør en vis længde på fibrene. Ved afkortningen sker der en fibrillering, hvilket bevirker, at enkeltfibrene ved den efterfølgende tørformningsproces kan danne en plade, som er sammenhængende uden behov for binder, idet fiberbundter griber ind i hinanden. Der etableres således interfiberbindinger i form af fiber-til-fiber bindinger imellem enkeltfibrene. Den dannede måtte behøver ikke at blive nålet, og tørreformningsprocessen sker også uden dampbinding af fibrene. Der er således tale om en meget enkel procedure for dannelse af fibermåtten. Den dannede fibermåtte er luftig og voluminøs og kan kompaktes til den grad, som ønskes, afhængigt af den tilsigtede anvendelse. Det vil ligeledes være muligt at tilføre binder i større eller mindre mængde afhængig af den ønskede anvendelse af det færdige produkt.

Traditionel høst af hør og hamp til tekstilproduktion sker ved ruskning, der er en langsommelig og arbejdskrævende proces. Efter ruskningen, hvor hele planten trækkes op, lægges denne til rødning. Efterfølgende presses stænglerne i baller og køres til fiber-

fabrik. På et skætteri afrives frøene, og stråene bearbejdes ved at placere stænglerne parallelt og behandle dem parallelt gennem behandlingsudstyr.

Til forskel fra ovennævnte traditionelle høst med ruskning kan der ved fremgangsmåden ifølge den foreliggende opfindelse etableres en forbehandling/høst af hør på en utraditionel måde. Dette sker for hør ved, at hørplanten afskæres, for eksempel ved, at den skårlægges, hvorefter hørfrøene tærskes, fortrinsvis ved mejetærskning. Hørstænglerne ligger i en passende tid efter frøhøstning, hvorved der sker rødning i det omfang dette ønskes. Hvis der således ønskes hørfibre, der er urødnede, bjærges hørstråene umiddelbart efter tærskning. Stænglerne bjærges for presning eller bjærges ved en kombineret snitning og presning.

Hamp høstes ved afskæring, for eksempel ved skårlægning, i to eller flere omgange. Således kan den første afskæring ske med en resterende stub på ca. 1 m's højde og derefter en skårlægning med en ca. 0,2 m høj stub. Efter afskæringen ligger hampstænglerne i en passende tid for rødning. Derefter presses stænglerne i baller og snittes og tørres før videre forarbejdning til dannelse af enkelt fibre, således som beskrevet ovenfor, for eksempel ved afkortning og skætning i hammermølle/slaglemølle og efterfølgende separering i sold, for eksempel roterende sold.

Forbehandlingen af stænglerne omfatter en afkortning og separering. I praksis har det vist sig, at en hammermølle er egnet til afkortning og samtidig skætning af stænglerne. Alternativt kan stænglerne være snittet før hammermøllen, således som nævnt i forbindelse med høstmetoder. Det har vist sig muligt at holde en høj kapacitet og en ensartet kvalitet, uanset hvorledes stænglerne indføres i hammermøllen. Der er således ikke behov for en langsommelig parallelføring af stænglerne, som anvendes på traditionelle hørskætterier.

Skætningen, det vil sige frigørelsen af veddelene fra fiberbundterne/enkeltfibrene, er meget effektiv, når der arbejdes med høje omdrejningstal på møllen. Ved denne proces afkortes stænglerne, således at hovedparten af de dannede fibre har en længde mellem 0,1 og 30 mm og fortrinsvis mellem 4 og 15 mm. Denne skætning eller fiberfrilæg-

ning er helt forskellig fra den traditionelle skætning, hvor der fremstilles meget lange plantefibre til kartning og spinding.

Rensningen af skæver fra fibre kan foregå med roterende sold eller lignende. I praksis er det vanskeligt at rense fibrene fuldstændig for skæver og fiberstøv. Imidlertid vil det være muligt at have en mindre andel som resterer i fibermassen, uden at dette forringer kvaliteten af de dannede fibermåtter. Således vil skævere i en vis udstrækning kunne anvendes ved den efterfølgende fremstilling af fibermåtten.

Til visse fibermåtter, hvor der ønskes anvendt en forpulpning af plantefibrene, for eksempel til fiberabsorbent, foretages en yderligere forbehandling af fibene, inden dannelse af fibermåtten. Forpulpning kan udføres, idet fibrene koges i vand under tryk eller koges i en ekstruder. Endvidere kan de behandles kemisk, for eksempel ved tilsætning af en base til vandet. Derefter vaskes og tørres de dannede fibre, inden de efterfølgende anvendes til tørformning. Alternativt kan der også foretages en vådrensning af fibermassen i dette fremstillingstrin. Således kan fibre, som er renset via sold og forpulpet, indføres i en hydrocyklon, hvorved det har vist sig muligt at frarense en meget stor andel af skæverne i den færdige pulp. Det har således vist sig muligt at fremstille en pulp, som kun her et indhold indtil 0,1% skæver. Idet skæverne fjernes, øges styrken i den fibermåtte, som efterfølgende dannes, idet fibermåtten vil indeholde flere fibre til fiberbindinger, idet fibermåtten indeholder flere fibre pr. arealenhed, da vægten af én skæver svarer til vægten af et stort antal fibre. I praksis har det vist sig muligt at øge styrken i det færdige produkt ved frarensning af skæver i en hydrocyklon. Da kapaciteten i hydrocyklonen er lav, er det fordelagtigt at frarense så mange skævere som muligt ved den tørre proces. Efterbehandlingen/rensningen i en hydrocyklon vil således fortrinsvis ske i forbindelse med fremgangsmåder, hvor forbehandlingen af fibrene omfatter en forpulpning.

De dannede fibre benyttes derefter til dannelse af fibermåtten ved en tørformningsproces, der i det væsentlige svarer til en tørformningsproces, som benyttes ved tørformning af papir.

De dannede enkeltfibre vil være mere eller mindre fibrillerede, hvilket øger tendensen til at fibrene er i stand til at vikle og rulle sig ind i hinanden. Der opnås således automatisk interfiberbindinger i fibermåtten. Til visse anvendelsesområder vil det således ikke være nødvendigt at tilsætte bindemidler. Imidlertid vil det også være muligt at tilsætte bindemidler for dannelse af interfiberbindingerne mellem enkeltfibrene. Den fibermåtte, som fremkommer, vil således have en homogen sammenhængende struktur over hele tykkelsen.

De bindere, som kan anvendes, kan være organiske bindere, syntetiske organiske bindere eller naturlige bindere. Som bindere kan anvendes polymerer, for eksempel thermoplast. Især ved dannelsen af kompositprodukter og højstyrkeprodukter, hvor den dannede fiberplade kan siges at være en fiberforstærkning, der befinder sig i en matrix af polymerer, kan der anvendes relative store andele af bindemidlerne. I sådanne produkter kan der således anvendes op til 50% bindemidler i forhold til det færdige produkt.

Bindemidlerne kan også være tilvejebragt i form af syntetiske fibre, for eksempel bikomponentfibre bestående af polypropylen og polyethylen, polyester, vinyl m.v. I en sådan situation vil pladens fiksering ske ved opvarmning til plastens smeltetemperatur, hvorved interfiberbindinger etableres. Som eksempler på naturlige bindemidler kan nævnes stivelse og mælkesyreprodukter. Sådanne bindemidler kan tilsættes i en andel på op til 5 - 15%.

Mængden og typen af bindemidler, der tilsættes, vil således afhænge af den tilsigtede anvendelse af den dannede fibermåtte. En fibermåtte, der er beregnet til isoleringsmåtte, vil således indeholde meget lidt eller intet bindemiddel. I modsætning hertil vil en kompositplade for eksempel egenskaber svarende til dem, som kendes fra fiber- og spånplader, indeholde en større mængde bindemiddel (10-50%), og bindemiddel samt fibermåtte vil gennemgå en komprimering, samtidig med at interfiberbindingerne etableres. Herved dannes en kompakt og stærk plade.

Endvidere vil det være muligt at variere egenskaberne for det dannede produkt ved at ændre på længderne af fibrene i produktet. Således kan det til visse produkter være fordelagtigt at en andel, for eksempel på 10% eller mere, af skæverne fra separationsprocessen tilføres tørformningsprocessen, således at der dannes en mere kompakt og stærk fibermåtte.

Hvis der ønskes fibermåtter, der er luftige og bløde, tilsættes der ikke skævere, og samtidig foretages der ikke nogen nævneværdig kompaktning af det tørformede lag. Endvidere vil der til sådanne luftige produkter anvendes plantefibre, fortrinsvis hørfibre, der er passende rødnet, således at de efter afkortning og separering indeholder mange fibriller, som er medvirkende til at give en sammenhængende fibermåtte, som samtidig er luftig.

Fibermåtterne vil ved fremgangsmåden ifølge opfindelsen kunne produceres betydeligt billigere end kartede/nålede fibermåtter. Fibrene kan formes til fibermåtter med tilsætning af meget lidt bindemiddel i forhold til formning af tilsvarende fibermåtter dannet af træfibre på grund af den større fiberlængde for de afkortede plantefibre. Således vil træfibre typisk have en længde mellem 1 og 3 mm, hvilket er væsentligt forskelligt fra den typiske længde af plantefibrene, der som nævnt ovenfor især vil være mellem 4 og 15 mm.

Som nævnt kan fibermåtten fremstilles uden anvendelse af bindemiddel eller med en meget lille mængde bindemiddel. Ved fremstilling af fibermåtter til isoleringsformål vil en tilsætning af bindemiddel i en andel på 0 - 15%, fortrinsvis på 2 - 3%, være nok til at etablere en sammenhængende fibermåtte af hør- og hampefibre, som er let at håndtere. Til sammenligning vil en tilsvarende isoleringsplade fremstillet af træfibre normalt indeholde 15 - 20% bindemiddel, hvilket er fordyrende for produktet.

Fibermåtterne kan som nævnt fremstilles luftige og bløde ved anvendelse af rødnede fibre, som giver mange fibriller ved afkortningen/separationen. Hvis plantefibrene kun er let rødnet eller urødnet, vil mange af plantefibrene stadig være sammenhængende i

fiberbundter. Dette giver en mere hård og grov fibermåtte, idet den dannede fibermasse vil indeholde en forholdsvis større andel af fiberbundter end enkeltfibre.

En fibermåtte, der indeholder fiberbundter, vil være mindre blød og tæt. Imidlertid er fiberstyrken i en sådan fibermåtte større. Dette vil gøre den egnet til fremstilling af plader, hvor der stilles større krav til styrke. Ved at regulere forbehandlingen i form af rødningsgrad, eventuelt kombinere med kemisk og/eller enzymatisk behandling, vil det således også være muligt at påvirke egenskaberne i den dannede fibermåtte.

Egenskaberne i fibrene kan således kombineres afhængigt af anvendelsesområdet.

Fiberbundterne vil omfatte nogle få enkeltfibre eller op til maksimalt 10 - 30 enkeltfibre.

Fibermåtterne vil almindeligvis være fremstillet af fibre, som er hydrofobe, idet fibre fra hør og hamp i større eller mindre grad er hydrofobe. En hydrofob fibermåtte dannes således ved anvendelse af fibre, der kun er behandlet mekanisk (ikke kemisk). Det vil sige, stænglerne er rødnet i kortere eller længere tid og tørret ned til et vandindhold mellem 8 - 18%, fortrinsvis mellem 10 - 16%. Graden af hydrofobitet afhænger af råvarekvaliteten. Jo kraftige rødning jo mindre grad af hydrofobitet. Fibrene kan absorbere fugt fra omgivelserne og afgive fugten igen og vil være bestandig overfor råd og angreb af skimmelsvampe ved normal luftfugtighed.

Alternativt vil det også være muligt at fremstille fibermåtter, hvor fibrene er gjort hydrofile. Det er således muligt at forbehandle fibrene via en forpulpning eller en enzymbehandling, en vaskning og en tørring for at videreforarbejde fibrene til cellulose. Dette kan ske ved en kogning i vand under tryk eller ved kogning i ekstrudere. En sådan forbehandling kan udføres med eller uden tilsætning af pulpningskemikalier, som for eksempel natriumhydroxid.

En fibermåtte, der er fremstillet efter en sådan fremgangsmåde, kan for eksempel anvendes hvor der er behov for absorberende effekt, som for eksempel hygiejnebind, bleer, tissue-papir m.v.

Tørformningsprocessen gør det muligt at fremstille fibermåtten med større eller mindre grad af kompaktning og med større eller mindre tykkelse. Det vil således være muligt at fremstille fibermåtterne med tykkelser fra 2 - 5 mm og op til tykkelser på 2 - 300 mm eller endda tykkere. De dannede fibermåtter kan fremstilles med kompaktning fra gramvægte på 30 g/m^2 til gramvægte på 3000 g/m^2 eller mere. For eksempel kan måtter til brug i formstøbte kompositelementer fremstilles med gramvægte på op til 8000 g/m^2.

Endvidere vil det ved fremstillingen af fibermåtten være muligt at iblande papiruld, bindemidler (syntetiske fibre eller organiske bindemidler), skæver fra hør eller hamp, træfibre eller iblande brandhæmningsmidler ved fremstilling af isoleringsmåtter med brandhæmmende egenskaber. De dannede fibermåtter kan således tilsættes brandhæmmende stoffer, som for eksempel salte som boraks og borsyre, aluminiumhydroxid, ammoniumfosfat, ammoniumsulfat eller andre, for eksempel i mængder på 0 - 15% af hele måttens vægt.

Ved fremstilling af fibermåtter i en luftig form vil de således kunne anvendes som isoleringsmåtter til erstatning for isoleringsmåtter fremstillet af mineraluld og glasuld. De dannede fibermåtter kan endvidere anvendes som byggeplader, som erstatning for fiber- og spånplader ved at tilføre skævere, bindemidler og foretage en presning af den dannede fibermåtte.

Fibermåtten, som er dannet ved en fremgangsmåde ifølge opfindelsen, kan indeholde op til 100% af hørfibre eller hampefibre eller en kombination af disse fibre. Endvidere kan fibermåtterne fremstilles med iblanding af andre fibre, som kan være organiske eller uorganiske. Selv om det af økonomiske grunde foretrækkes at fremstille fibermåtterne udfra plantefibre, der er dannet ved fremgangsmåden ifølge opfindelsen, vil det også være muligt at benytte plantefibre, der er dannet til lange fibre, såkaldt blår.

Det vil således være muligt at anvende blår fra tekstilindustrien stammende fra såvel hør som hamp, og hvor blåren, for eksempel i hammermøller, afkortes til de ønskede fiberlængder inden formningen af fibermåtten ved tørformningsprocessen.

De fibre, som kan benyttes ved fremgangsmåden ifølge opfindelsen, kan have forskellige sammensætninger:

- afkortede fibre, der er rødnet eller urødnet, bestående af renset hør- og/eller hampefibre iblandet op til 10% skæver,
- afkortede fibre, der er rødnet eller urødnet, primært som enkeltfibre, bestående af hør- og/eller hampefibre iblandet skævere fra hør og/eller hamp med op til 90% skævere,
- korte fibre, der er rødnet eller urødnet, primært som fiberbundter og skæver fra hør og/eller hamp,
- frarensede skæver af hør og/eller hamp, eller
- frarenset støvfraktion bestående af meget korte fibre samt skævere.

Fiberkvaliteten vil afhænge af de ønskede egenskaber ved det dannede slutprodukt. Ved en fordelagtig fremgangsmåde til fremstilling af fibermåtter, der er egnet som isoleringsmåtter, tørres plantestænglerne til et vandindhold, der er mellem 10 og 16%. Derefter skættes og afkortes stænglerne i en hammermølle, således at hovedparten af fibrene fortrinsvis har en længde mellem 3 og 20 mm, hvor fibrene vil have en gennemsnitslængde mellem 4 og 15 mm. Dette sker fordelagtigt ved anvendelse af et roterende sold. Derefter tørformes fibrene, hvilket fortrinsvis sker ved anvendelse af et formerhoved, der er placeret over en vakuumkasse, hvorimellem der er anbragt en formerwire, hvorpå fibrene aflejres og fastholdes af et vakuum. Fikseringen sker ved en kompaktning samt tilføring af 0 - 5% bindemiddel. Alternativt kan der dog anvendes op til 50% bindemiddel, hvis der stilles særlige store krav til den dannede fibermåttes håndterbarhed.

En fibermåtte, som dannes ved fremgangsmåde ifølge opfindelsen, behøver ikke være en plan plade. Således vil det være muligt, at der foretages en slutbehandling samtidig med fikseringen eller i umiddelbar tilknytning til fikseringen af interfiberbindingerne.

Således vil det være muligt at bibringe fibermåtten en rumlig form, for eksempel en onduleret form, som gør den egnet som forstærkningsfibre i en kompositplade, for eksempel en højstyrke-kompositplade eller en formbar kompositplade. Alternativt kan fibermåtten tildannes, så den får form som en ønsket emballage, for eksempel en kasseform eller et bægerform. Således vil en fibermåtte, der er formstabil og fast, kunne anvendes ved fremstilling af emballageprodukter eller plantepotter. Selve emballagen/plantepotten kan dannes ved en presseoperation i umiddelbar tilknytning til fikseringstrinnet.

Fremgangsmåden samt fibermåtten ifølge opfindelsen vil blive beskrevet nærmere ved hjælp af efterfølgende eksempler.

Eksempel 1.

Dette eksempel illustrerer en fremgangsmåde til fremstilling af en fibermåtte af hør til anvendelse som isoleringsmåtter til erstatning for mineraluld. Såvel strå fra hør, både olie- og spindhør, samt hamp kan anvendes. De bedste fibre fås fra spindhør, der er velrødnet samt evt. hamp, såfremt den er rødnet tilstrækkeligt. Her er givet et eksempel med fremstilling af fibermåtter til isolering på basis af spindhør:

Hørstrået skårlægges og efter ca. 10 dage på skår mejetærskes frøene med en almindelig mejetærsker. Herefter ligger halmstrået i en halmstreng/skår på marken og rødner. Rødningsprocessen kan følges ved at konstatere farveskift i strået. Den ønskede rødningsgrad er opnået, når farven på strået/fibrene skifter til lysgrå. Det kan komme på tale at vende skåret for at sikre en ensartet rødning.

Rødningsprocessen følges nøje, og der udtages daglig prøver for at konstatere hvor langt fremskreden rødningsprocessen er i håndskættede strå.

Når det ønskede farveskift er indtrådt bjerges halmen ved presning i baller, helst rundballer, normalt sker dette ved et tørstofindhold på ca. 85% i halmen (15 % vand).

Ballerne transporteres til fabrikken, hvor de tørres ned til 12% vandindhold. Efter nedtørring oprulles/oprives ballen, og hørstrået føres ind i hammermøllen, hvor skætningen foregår. Fra møllen føres fibermassen, der nu består af såvel fibre som veddele/skævere via cyklon over i et roterende sold, hvorved skæverne samt støv sorteres fra. Den nu uldne fibermasse har en gennemsnitslængde på ca. 4 - 15 mm. En del fibre er dog længere. Fiberlængden kan til en vis grad tilpasses ved at regulere soldet på hammermøllen samt ved at regulere indstillingen af soldet ved den efterfølgende sortering på det roterende sold. Normalt renses fibrene indtil et indhold på 5% skæver. Ved yderligere rensning opnås et forholdsmæssigt større tab af fibre.

Den rensede fibermasse transporteres via rør til måtteanlægget, hvor der sker en tørformning. Dette sker for eksempel ved anvendelse af et formerhoved, der er placeret over en vakuumkasse, hvorimellem der er anbragt en formerwire, hvorpå fibrene aflejres og fastholdes af et vakuum. Måtteanlægget indstilles til at forme en fibermåtte/måtte i den ønskede højde. Dette reguleres vha. hastigheden hvorved fiberføder (balebreaker) doseres via transportblæser til formerhoved. Samtidig reguleres fremkørselshastigheden på wire.

Ønskes fremstillet en måtte til brug som isolering af lofter og vægge m.v. reguleres højden på fibermåtten til for eksempel 200 mm med en ønsket gramvægt på for eksempel 3000 g/m^2. Til visse isoleringsformål ønskes en så let fibermåtte som muligt, under disse forhold bliver fibermåtten ikke kompaktet.

Ønskes fremstillet en fibermåtte, der er mere kompakt og evt. af mindre højde foregår det ved at regulere grad af kompaktning af fibermåtten før, efter eller under en eventuel fiksering, der fortrinsvis foretages i ovn.

Under processen hvor fibrene drysser ud på formerwirer og føres frem tilføres 2- 3% binder for eksempel i form af en bikomponent bestående af polyethylen og polypropylen. Fiksering af fibermåtten sker ved en varmebehandling i ovn ved ca. 145°C eller anden temperatur afhængig af bindertype, det vil sige fibermåtten føres via formerwire gennem en ovn med den ønskede temperatur.

Under processen (inden fiksering i ovn) tilføres evt. brandhæmmende stoffer som for eksempel salte som boraks (0-15%), borsyre (0-15%), aluminiumhydroxid (0-15%) eller andre. Saltene kan drysse ned i fibrene eller de kan sprøjtes på fibrene.

Efter fiksering af fibermåtten rulles den op via en opruller og emballeres eller udskæres. Under denne proces kan fibermåtten rulles hårdt sammen. Ved oprulning opnår fibermåtten samme størrelse og volumen som inden oprulning, idet fibermåtten puffer op.

Den færdige fibermåtte er blød og smidig. Farven vil afhængig af rødningsgrad være gullig/lys grå til mørkere grå. Fibermåtten vil kunne fremstilles til en billigere pris end de gængse nåle-kartede fibermåtter. Fibermåtten har en varmeisolering svarende til en lambdaværdi på -0,40. Umiddelbart skyer fibermåtten fugt på grund af hydrofobe egenskaber, men fibermåtten er dog i stand til at optage og afgive fugt med omgivelserne.

Eksempel 2.

Dette eksempel illustrerer en metode til fremstilling af fibermåtte på basis af hørcellulose til brug i tissueindustrien som for eksempel absorberende papir eller som cover stocks.

Fibrene fremstilles som overfor i eksempel 1. beskrevet inden måtteformning. Rødningsgrad kan være fra helt urødnede til kraftigt rødnede fibre. De nu rensede uldne fibre udsættes for en forpulpning. Dette kan ske ved kogning i vand under tryk eller ved kogning i ekstruder. Forbehandlingen gennemføres med eller uden tilsætning af pulpningskemikalier for eksempel kaustisk soda (natriumhydroxid). Behandling i ekstruder kan forløbe ved relativt højt tørstofniveau, ca. 10%, men også ved lavere tørstofprocent.

Anvendes ekstruderbehandling foregår imprægnering af fibrene samtidig med en opskæring af fibermassen. Efter ekstruderbehandling føres fibermassen over i en beholder, og koges ca. 1. time ved knap 100°C. Efterfølgende vaskes pulpen for sukker- og

ligninrester. Fibermassen består nu af en homogen fordeling af fibre i en opslemning, der indeholder fra 0 - 5% urenheder primært stammende fra skæverne. Disse kan frarenses via en centricleaning i hydrocyklon. Pulpen kan eventuelt forud for rensning i hydrocyklon raffineres i en refiner, hvis der ønskes en fibrillering af fibrene. For eksempel en skiveraffinør, "wide angle"- refiner eller for eksempel en skæremølle.

Pulpen af hør består efter forpulpning af næsten ren cellulose med et indhold på 80 - 95% cellulose. Tørstofudbyttet er mellem 75 - 90%. Fiberlængdefordelingen er målt med Bauer McNett index mellem 200 - 300, fortrinsvis mellem 240 - 280. Styrken i hørcellulosen er målt i $Nm/m^2/cm^2$ fra 100 - 160 eller mere.

Ønskes bleget pulp kan tilsættes 2% peroxid og der opnås en lyshed på ca. 75 (Bligthness).

Den færdige pulp tørres og defibreres i en slaglemølle/hammermølle, såfremt fibrene ønskes helt defibreret inden formning til fibermåtte. Formning foregår som beskrevet i eksempel 1, men der fremstilles en tyndere måtte afhængig af anvendelsesformål som for eksempel ved anvendelse til absorberende papir til brug i bind og lignende (ca. 70- ca. $200 g/m^2$) En meget tynd måtte ($20 g/m^2$) vil kunne anvendes som coverstock ved iblanding af ca. 15% eller mindre hydrofobe bindere.

Produkterne er selv uden blegning af pulpen meget lyse fra lysgrå til hvidlig.

Eksempel 3.

Dette eksempel illustrerer en metode til fremstilling af formstøbte kompositter på basis af fibermåtten af hamp eller hør.

Som udgangspunkt for at opnå en fiberplade af høj styrke er det muligt at anvende forholdsvis urødnede fibre evt. iblandet skævere. Fiberstyrken i urødnede til let rødnede fibre er højere end for stærkt rødnede fibre. Såvel hør som hamp vil være velegnet råmateriale grundet fibrenes høje styrke. De frarensede veddele, skæver, vil også kunne anvendes til kompositter svarende til spånplader.

Fibermåtten fremstilles som overfor i eksempel 1. beskrevet inden måtteformning. Der fremstilles en fibermåtte af ønsket højde og gramvægt, for eksempel 300 g/m^2. Fibermåtten er ved anvendelse af forholdsvis urødnet hør eller hamp meget stiv og hård. Indholdet af skæver kan tilpasses efter ønske. Jo højere indhold desto stivere måtte inden formstøbning.

Under måttefremstillingen påsprøjtes en såkaldt plantefibercompatiliser, det vil sige en kemisk modifikation med for eksempel isocyanat (ca. 1 - 2%) for at sikre de hydrofobe fibre får en overflade, der er forenelig med traditionelle bindere, såsom formaldehyd m.fl., der anvendes som binder i fiberpladen. I stedet for tilsætning af formaldehyd kan EVA (evanylacetat) eller naturlige bindemidler være en mulighed.

Ligeledes belimes fibrene inden, under eller umiddelbart efter måttefremstillingen eller umiddelbart efter inden presning ved varme, vakuum eller autoklave/støbning, som de traditionelle metoder til fremstilling af fiberplader og spånplader.

De formstøbte kompositter baseret på hør- eller hampefibre har en styrke på linie med hård masonit.

Ønskes fremstillet en højarmeringskomposit anvendes en større andel organiske bindere såsom syntetiske polymere, der omfatter termoplaster og hærdeplaster for eksempel polypropylen, polylactat og polyester. Der tilsættes ca. 50% binder. Tilsætning af binder foregår under måttefremstillingen, og fibermåtten højtrykspresses efterfølgende til de ønskede faconer. Forming forløber som beskrevet under eksempel 1.

Højarmeringskompositterne har en styrke på højde med glasfiber, og er anvendelige som erstatning for plastkompositter og glasfiberkompositter.

PATENTKRAV

1. Fremgangsmåde til fremstilling af en fibermåtte under anvendelse af plantefibre, hvor fibrene forbehandles, idet planterne høstes ved afskæring samt tærskning, hvor plantestængler rødnes helt eller delvis og derefter afkortes og separeres for etablering af en fibermasse omfattende stort set enkeltfibre med længder indenfor det ønskede interval mellem 0,1 og 30 mm, hvor tørring eventuelt foretages for tilvejebringelse af et ønsket vandindhold, hvor fibrene orienteres tilfældigt, idet måtten dannes ved en tørformningsproces, og hvor måtten fikseres, idet interfiberbindinger i det mindste delvis etableres mellem enkeltfibrene, idet disse er mere eller mindre fibrillerede.

2. Fremgangsmåde ifølge krav 1, k e n d e t e g n e t ved, at forbehandlingen omfatter en afkortning af fibrene til en længde mellem 3 og 20 mm og især mellem 4 og 15 mm.

3. Fremgangsmåde ifølge krav 1 eller 2, k e n d e t e g n e t ved, at fibrene rødnes delvis på marken, og at de derefter bibringes en eventuel yderligere styret rødning i vand tilsat enzymer inden afkortningen.

4. Fremgangsmåde ifølge et hvilket som helst af de foregående krav, k e n d e t e g n e t ved, at interfiberbindingerne etableres ved påføring af organiske bindere, syntetiske organiske bindere eller naturlige bindere.

5. Fremgangsmåde ifølge et hvilket som helst af de foregående krav, k e n d e t e g n e t ved, at fibrene vælges blandt hør og hamp.

6. Fremgangsmåde ifølge et hvilket som helst af de foregående krav, k e n d e t e g n e t ved, at stænglerne i en hammermølle skættes og afkortes til ønsket længde, at fibre indenfor ønsket længdeinterval separeres ved anvendelse af et roterende sold, at fiberfraktionen tørformes til en måtte, idet fibrene indblæses i et formerhoved, der er anbragt over en formerwire.

7. Fremgangsmåde ifølge et hvilket som helst af de foregående krav, k e n d e t e g n e t ved, at den dannede måtte fikseres ved tilførsel af mellem 0 og 50% binder.

8. Fremgangsmåde ifølge et hvilket som helst af de foregående krav, k e n d e t e g n e t ved, at den dannede måtte indeholder mellem 0 og 10% skæver.

9. Fremgangsmåde ifølge krav 1, k e n d e t e g n e t ved, at afkortning og separation af fibre foretages i tør tilstand, og at forbehandlingen omfatter, at fibrene forpulpes, idet fibrene koges i rent vand under tryk eller koges i en ekstruder, at de behandles kemisk, for eksempel ved tilsætning af base, at de vaskes, og at de tørres inden de dannede fibre tørformes.

10. Fibermåtte fremstillet ved en fremgangsmåde ifølge et hvilket som helst af de foregående krav, k e n d e t e g n e t ved, at den har karakter som en non-woven måtte og er fremstillet med tykkelser mellem 2 og 300 mm og med gramvægte mellem 30 og 8000 g/m^2.

11. Anvendelse af en fibermåtte fremstillet ved en fremgangsmåde ifølge et hvilket som helst af kravene 1-9 som isoleringsmåtte, som absorberende fibermåtte, som element i formstøbt kompositprodukt eller som element i et højarmeringskompositprodukt.

SAMMENDRAG

FREMGANGSMÅDE TIL FREMSTILLING AF EN FIBERMÅTTE, FIBERMÅTTE SAMT ANVENDELSE AF EN SÅDAN FIBERMÅTTE.

Der beskrives en ny metode til fremstilling af fibermåtter under anvendelse af plantefibre, fortrinsvis fra hør og hamp.

Fibrene forbehandles og afkortes, hvorefter de separeres for etablering af en fibermasse omfattende enkeltfibre med længder inden for et ønsket interval. Herefter fremstilles fibermåtten ved en tørformningsproces, idet fibrene orienteres tilfældigt i fibermåtten. Tørformningsprocessen vil fortrinsvis ske ved anvendelse af et formerhoved, der er placeret over en vakuumkasse, idet fibrene aflejres på en formerwire imellem disse to elementer. Pladen fikseres, idet der etableres interfiberbindinger mellem enkeltfibrene. Interfiberbindingerne kan etableres med eller uden anvendelse af bindemidler.

De dannede fibermåtter vil være åbne og luftige men samtidig tilstrækkelig stabile og sammenhængende til håndtering. Et anvendelsesområde for fibermåtten vil være til isoleringsformål.

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference 9249PC/LN/ar	FOR FURTHER ACTION	see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.
International application No. PCT/DK 99/00239	International filing date *(day/month/year)* 29 April 1999	(Earliest) Priority Date *(day/month/year)* 1 May 1998
Applicant Eriksen,Marianne Etlar		

This international search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of 3 sheets.

[X] It is also accompanied by a copy of each prior art document cited in this report.

1. [ ] **Certain claims were found unsearchable (See Box I).**

2. [ ] **Unity of invention is lacking (See Box II).**

3. [ ] The international application contains disclosure of a **nucleotide and/or amino acid sequence listing** and the international search was carried out on the basis of the sequence listing
   - [ ] filed with the international application.
   - [ ] furnished by the applicant separately from the international application,
     - [ ] but not accompanied by a statement to the effect that it did not include matter going beyond the disclosure in the international application as filed.
   - [ ] transcribed by this Authority.

4. With regard to the **title**,
   - [X] the text is approved as submitted by the applicant.
   - [ ] the text has been established by this Authority to read as follows:

5. With regard to the **abstract**,
   - [X] the text is approved as submitted by the applicant.
   - [ ] the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is:
   Figure No. ---
   - [ ] as suggested by the applicant.
   - [ ] because the applicant failed to suggest a figure.
   - [ ] because this figure better characterizes the invention.
   - [ ] None of the figures.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/DK 99/00239

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: D04H 1/42, D01B 1/10, D21C 5/00
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: D04H, D01B, A01D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPI,EPODOC,PAJ GERMAN FULLTEXT DATABAS SES

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 9633306 A1 (ECCOGLEITTECHNIK GMBH), 24 October 1996 (24.10.96), page 3, line 35 - line 38; page 4, line 6 - line 26, example 1	1-7,10-11
Y		9
	--	
X	WO 9801611 A1 (OY SCANWOVEN AB), 15 January 1998 (15.01.98), page 2, line 10 - line 34; page 5, line 5 - line 7; page 8, line 34 - page 9, line 7, claims	8
A		1-7,9-11
	--	

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" erlier document but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
17 August 1999	09 -09- 1999
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INTERNATIONAL SEARCH REPORT

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(54) Title: METHOD FOR MANUFACTURING A FIBRE MAT, FIBRE MAT AND USE OF SUCH FIBRE MAT

(57) Abstract

There is described a new method for making a fibre mat under the use of plant fibres, preferably from flax and hemp. The fibres are pre–treated and shortened, whereafter they are separated for establishing a fibre mass comprising single fibres with lengths within a desired interval. Hereafter, the fibre mat is produced by a dry–forming process as the fibres are oriented randomly in the fibre mat. The dry–forming process preferably takes place by using a former head which is placed above a vacuum box as the fibres are deposited on a former wire between these two elements. The plate is fixed as inter–fibre bonds are established between the single fibres. The inter–fibre bonds may be established with or without the use of binders. The formed fibre mats will be open and airy, but at the same time sufficiently stable and cohesive for handling. A field of application for the fibre mat will be isolation.

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METHOD FOR MANUFACTURING A FIBRE MAT, FIBRE MAT AND USE OF SUCH FIBRE MAT

Background of the invention

The present invention concerns a method for manufacturing a fibre mat using plant fibres. More specific, the invention concerns a use of flax fibres and hemp fibres for manufacturing fibre mats which are made by using fibres which are shortened and separated and which afterwards are used for manufacturing the fibre mat. The plant fibres are used as substitute for mineral wool fibres, wooden fibres, wooden cellulose, synthetic fibres etc.

Furthermore, the invention concerns a fibre mat manufactured by the method according to the invention, as well as the invention also concerns a use of such a fibre mat.

It is known to use plant fibres by the making of fibre mats. Such were formed by carding the fibres. Thereafter a fur is formed and finally a needling is performed for making the finished fibre mat. Such a method is connected with several drawbacks. It has thus been necessary to have a precise degree of humidity in the flax out of consideration to the pliability in order to perform the needling process. However, a necessary dry condition will result in decomposition of flax fibres and thereby cause dust formation and formation of short fibres which very easily could be torn out of the formed fibre mat. It has thus been an expensive process, and at the same time there has been a risk of dust formation from the formed fibre mat.

The manufacture of the known carded fibre mats will cause that the fibres are lying in separate piles so that there is no strong bonds between the single layers in the fibre mat. Furthermore, there is used relatively long fibres, which typically will be between 100 - 150 mm, but may be up to 200 mm. Fibre mats of flax and hemp are made traditionally from tow which is a by-product when making long fibres for carding and spinning. This takes place at flax scutching mills. The process is expensive and difficult and therefore tow together with long textile fibres from plant fibres, such as flax and hemp, are relatively expensive. Furthermore, the known technique has great re-

quirements to the quality of raw materials, including the degree of retting of the raw materials.

Flax plants can have a stem with a length between 600 and 800 mm. The stem has strong fibre bundles running from root to top. These fibre bundles (fibres) are disposed outermost in the stem, and in the interspace between the fibre bundles there is a central stalk consisting of wood cells which after exposure of fibres gives the so-called shives.

Hemp plants have stems which are considerably longer than the stem of the flax plants. They may have lengths up to 2,000 - 3,000 mm. In principle, the hemp stem is build up in the same way as flax with the fibre bundles outermost. Innermost is situated the wood containing wood cells (shives) consisting of short fibres with a length of 0.5 - 0.6 mm (elementary fibre length).

In order to separate the flax fibres from the wood fibres in the stem, it has to be subjected to a retting which is a microbiological process. Traditionally this takes place on the field by dew-retting. By the retting hemicellulose and pectin binding together the fibres and the wood parts are decomposed. The degree of retting is all decisive in the making of textile fibres for carding and spinning. Thus the border between a well retted and over retted fibre is very narrow. This is a difficult process to control because it will be a biological process in the nature that determines the quality.

By the present invention there is not the same requirement to a specific degree of retting. By the process according to the present invention it is thus possible to use a traditional retting or a controlled retting, for example in water containing enzymes. It is thus possible to expose and use fibres from a completely un-retted to a strongly over-retted quality depending on the purpose of use. It is thus possible to use stems that are not retted, which have been dew-retted on the field, or which have been retted by a controlled retting. After the retting and drying, flax is subjected to a mechanical treatment for separating the fibre bonds from the shives. The formed fibres may be shortened by cutting in order to form the desired lengths of fibre.

By a slight retting and subsequent mechanical and possible chemical treatment it is possible to decompose the fibre bundles and form single fibres. The single fibres may be used performing more airy products than is the case when making products from fibre bundles. However, it has been stated that the formed single cell fibres are not suitable for making fibre mats by the known needle processes because of the shortening into lengths making them unsuitable for carding.

By the present invention there is focused especially on flax fibres and hemp fibres, but the invention may also be used in connection with other plant fibres with a structure corresponding to the one known from flax and hemp plants.

There is a wish of a new method whereby plant fibres, preferably flax fibres and hemp fibres, may be utilised for making fibre mats, which is not connected with the drawbacks of known carded or needled fibre mats, and which also may be used industrially in a long series of products.

A method in which the carding and needle process has been left out has thus been proposed previously. From WO 98/01611 there is thus known a method for making a fibre product where the fibres are pre-treated with the combination of retting and mechanical decomposition. The formed fibres are afterwards formed to the final product by a dry forming process. However, there is no specific indication of subprocesses for providing fibres with the properties which are desirable in the final product. Furthermore, the described method is based on the use of relatively long fibres which may have a length corresponding to the fibres from a carding process. Such long fibres may cause difficulties in the process steps forming a part of the method. Furthermore, there is no direction for7 harvesting the fibres in an effective way on a suitable process step under consideration of the subsequent treatment.

It is thus an object of the invention to indicate a method for manufacturing a new kind of fibre mat and to indicate subprocesses which are advantageous at the providing of the fibres with a quality being suitable in the process and which results in final prod-

ucts with the desired properties. It is furthermore an object to indicate a fibre mat which is made by the method and to indicate a specific use of such a fibre mat.

The object of the invention is achieved by a method where the fibres are pre-treated as the plants are harvested by cutting and threshing, where the plant stems are retted wholly or partially and thereafter shortened and separated for establishing a fibre mass comprising largely single fibres with lengths within the desired interval between 0.1 and 30 mm, where drying is possibly performed for providing a desired water content, where the fibres are randomly oriented as the mat is formed by a dry forming process, and where the mat is fixed as inter-fibre bonds at least partially are established between the single fibres as these are more or less fibrillated.

With this method there is thus established a pre-treatment, where the fibres are shortened and separated for forming a fibre mass mainly containing single fibres with lengths within the desired interval with a length being so short that they are not suitable for carding. A shortening may be performed arbitrarily in suitable equipment, as the subsequent process do not require carding and thereby do not necessitate a certain length of the fibres. By the shortening, a fibrillation takes place which causes that the single fibres at the subsequent dry-forming process may form a sheet which is cohesive without need of a binder, as fibre bundles mesh with each other. Thus there is established inter-fibre bonds in the form of fibre-to-fibre bonds between the single fibres. The formed mat do not need to be needled and the dry-forming process also takes place without steam bonding of the fibres. We are thus speaking of a very simple procedure for forming the fibre mat. The formed fibre mat is airy and voluminous and may be compacted to the desired degree, depending on the intended use. It will also be possible to add binder in a greater or lesser amount depending on the desired use of the finished product.

Traditional harvesting of flax and hemp for textile production takes place by pulling which is a slow and work intensive process. After the pulling where all of the plant is pulled up, it is laid aside for retting. Subsequently the stems are pressed into bales and driven to fibre factory. The seeds are torn off in a scutching mill and the straws are

processed by placing the stems in parallel and treating them in parallel through processing equipment.

As a difference from the above-mentioned traditional harvest with pulling, by the method according to the present invention there may be established a pre-treatment/harvest of flax in an untraditional way. This takes place for flax by cutting off the flax plant, for example by laying it in swaths, where after the flax seeds are threshed, preferably by combined harvesting. The flax stems lie a suitable time after the harvest of seeds whereby retting takes place to the desired extent. Thus, if unretted flax fibres are desired, the flax straws are gathered immediately after threshing. The stems are gathered for pressing or gathered by a combined cutting and pressing.

Hemp is harvested by cutting, for example by laying in swaths, in two or more rounds. Thus, the first cutting may take place with a remaining stubble of about 1 m in height and thereafter a laying swaths with a stubble of about 0.2 m in height. After being cut off, the hemp stems are lying a suitable time for retting. Then the stems are pressed into bales and cut and dried before further processing for forming single fibres as described above, for example by shortening and scutching in a hammer mill/beater mill and subsequent separation in a riddle, for example a rotating riddle.

The pre-treatment of the stems comprises shortening and separation. In practice it has appeared that a hammer mill is suitable for shortening and simultaneous scutching of the stems. Alternatively, the stems may be cut before the hammer mill as mentioned in connection with harvesting methods. It has appeared to be possible to keep a high capacity and a uniform quality irrespectively how the stems are fed into the hammer mill. There is thus not a need for a slow feeding in parallel of the stems used on traditional flax scutching mills.

The scutching, that is the liberating of the wood parts from the fibre bundles/single fibres, is very effective when working with high rpm's on the mill. With this process the stems are shortened so that the main part of the formed fibres have a length between 0.1 and 30 mm and preferably between 4 and 15 mm. This scutching or fibre

exposure is completely different from the traditional scutching where very long plant fibres are produced for carding and spinning.

The cleaning of shives from fibres may take place with a rotating riddle or the like. In practice it is difficult to clean the fibres completely from shives and fibre dust. However, it will be possible to have a lesser part remaining in the fibre mass without this reducing the quality of the formed fibre mat. Thus, to a certain extent, shives may be used at the subsequent manufacture of the fibre mat.

For some fibre mats where use of pulping of the plant fibres is desired, for example for fibre absorbent, there is performed a further pre-treatment of the fibres before the forming of the fibre mat. Pulping may be performed as the fibres are boiled in water under pressure or boiled in an extruder. Furthermore, they may treated chemically, for example by adding a base to the water. Thereafter the formed fibres are washed and dried before they subsequently are used for dry-forming. Alternatively, there may also be performed a wet cleaning of the fibre mass in this manufacturing step. Thus the fibres which are cleaned through a riddle and pulped, may be fed to a hydrocyclone, whereby it has appeared to be possible by cleaning to remove a very large part of the shives in the finished pulp. It has thus appeared possible to make a pulp which only has a content of up to 0.1 % shives. As the shives are removed, the strength is increased in the subsequently formed fibre mat, as the fibre mat will contain more fibres for fibre bonds, as the fibre mat contains more fibres per area unit, because the weight of one shive corresponds to the weight of a large number of fibres. In practice it has appeared possible to increase the strength in the finished product by cleaning off shives in a hydrocyclone. Because the capacity in the hydrocyclone is low, it is advantageous to clean off as many shives as possible by the dry process. The subsequent treatment/cleaning in a hydrocyclone will thus preferably take place in connection with methods where the pre-treatment of the fibres comprises a pulping.

The formed fibres are then used for forming the fibre mat by a dry-forming process which substantially corresponds to a dry-forming process used in the dry-forming of paper.

The formed single fibres will be more or less fibrillated which increases the tendency of the fibres being able to wind and roll into each other. Thus there is automatically achieved inter-fibre bonds in the fibre mat. For some application areas it will thus not be necessary to add binders. However, it will also be possible to add binders in order to form inter-fibre bonds between the single fibres. The appearing fibre mat will thus have a homogenous cohesive structure through the whole thickness.

The binders that can used may be organic binders, synthetic organic binders, or natural binders. As binders may be used polymers, for example thermoplastic. Especially at the forming of composite products and high strength products where the formed fibre sheet may be said to be a fibre reinforcement situated in a matrix of polymers, there may be used relatively large amounts of the binders. In such products there will thus be used up to 50% binders in relation to the finished product.

The binders may also be provided in the form of synthetic fibres, for example bi-component fibres consisting of polypropylene and polyethylene, polyester, vinyl etc. In such a situation the fixation of the sheet will take place by heating up to the melting temperature of the plastic, whereby inter-fibre bonds are established. As examples of natural binders can be mentioned starch and lactic acid products. Such binders may be added as a part up to 5 -15%.

The amount and type of binders added will thus depend on the intended use of the formed fibre mat. A fibre mat intended for isolation mats will thus contain very little or no binder. Contrary to this, a composite sheet, for example, has properties corresponding to those known from fibre and chip-boards will contain a larger amount of binder (10 - 50%), and binder and fibre mat will go through a compression simultaneously with the establishing of the inter-fibre bonds. Hereby a compact and strong sheet is formed.

Furthermore, it will be possible to vary the properties of the formed product by changing the length of the fibres in the product. Thus for certain products it will be advantageous that a part, for example of 10% or more, of the shives from the separa-

tion process is fed to the dry-forming process so that a more compact and strong fibre mat is formed.

If airy and soft fibre mats are desired, shives are not added and at the same time there is not performed any noticeable compacting of the dry-formed layer. Furthermore, for such airy products there will be used plant fibres, preferably flax fibres, that are suitable retted so that they after shortening and separation contain many fibrils contributing to obtain a cohesive fibre mat which at the same time is airy.

By the method according to the invention, the fibre mats may be produced considerably cheaper than carded/needled fibre mats. The fibres may be formed to a fibre mat with the addition with very little binder as compared to forming of corresponding fibre mats formed of wood fibres because of the longer fibre length of the shortened plant fibres. Thus wood fibres will typically have a length between 1 and 3 mm, which is considerably different from the typical length of plant fibres, which as mentioned above will be especially between 4 and 15 mm.

As mentioned, the fibre mat may be made without the use of binder or with a very little amount of binder. When making fibre mats for isolation purposes an addition of binder in a part of 0 - 15%, preferably of 2 - 3%, will be enough to establish a cohesive fibre mat of flax and hemp fibres which are easy to handle. In comparison, a corresponding isolation plate made from wood fibres will normally contain 15 - 20% binder, which increases the price of the product.

As mentioned, the fibre mats may be made airy and soft by the use of retted fibres resulting in many fibrils by the shortening/separation. If the plant fibres only are slightly retted or not retted, many of the plant fibres will still be cohesive in fibre bundles. This gives a more hard and rough fibre mat as the formed fibre mass will contain a relatively larger part of fibre bundles than single fibres.

A fibre mat containing fibre bundles will be less soft and dense. However, the fibre strength in such a fibre mat is greater. This will make it suitable for making plates to

where greater strength is required. By regulating the pre-treatment in a form of degree of retting, possibly combined with chemical and/or enzymatic treatment, it will thus also be possible to influence the properties in the formed fibre mat.

The properties in the fibres may thus be combined, depending on the field of application.

The fibre bundles will comprise a few single fibres or up to a maximum of 10 - 30 single fibres.

The fibre mats will usually be made of fibres which are hydrophobic as fibres from flax and hemp to a greater or lesser degree are hydrophobic. A hydrophobic fibre mat is thus formed by the use of fibres which are only treated mechanically (not chemically). I.e. the stems are retted in a shorter or longer period of time and dried down to a water content between 8 - 18%, preferably between 10 - 16%. The degree of hydrophobicity depends on the raw material quality. The stronger retting, the lesser degree of hydrophobicity. The fibres may absorb humidity from the surroundings and give off the humidity again and will be resistant to rot and attacks from mould fungus at normal atmospheric humidity.

Alternatively, it will also be possible to make fibre mats where the fibres have been made hydrophilic. It will thus be possible to pre-treat the fibres via a pulping or enzyme treatment, a washing and a drying in order to further process the fibres to cellulose. This may take place by boiling in water under pressure or by boiling in extruders. Such a pre-treatment may be performed with or without addition of pulping chemicals, as for example sodium hydroxide.

A fibre mat made according to such a method may for example be used where there is a need for an absorbing effect, as for example sanitary tissues, napkins, tissue paper etc.

The dry-forming process makes it possible to make the fibre mat with greater or lesser degree of compacting and with greater or lesser thickness. It will thus be possible to make the fibre mats with thicknesses from 2 - 5 mm and up to thicknesses of 2 - 300 mm or even thicker. The formed fibre mats may be manufactured with compacting from gram weights of 30 g/m^2 to gram weights of 3000 g/m^2 or more. For example, mats for use in moulded composite elements may be manufactured with gram weights up to 8000 g/m^2.

Furthermore, by the making of the fibre mat it will be possible to admix paper wool, binders (synthetic fibres or organic binders), shives from flax or hemp, wood fibres, or to admix fire-retardants by making isolating mats with fire-resistant properties. The formed fibre mats may thus be added fire-resistant materials, as for example salts as borax and boric acid, aluminium hydroxide, ammonium phosphate, ammonium sulphate, or others, for example in amounts of 0 - 15% of the total weight of the mat.

By making fibre mats in an airy form they may thus be used as isolating mats for substituting isolating mats made of mineral wool and glass wool. The formed fibre mats may furthermore be used as building plates, as substitute for fibre boards and chip-boards by adding shives, binders, and by performing a pressing of the formed fibre mat.

The fibre mat formed by a method according to the invention may contain up to 100% flax fibres or hemp fibres or a combination of these fibres. Furthermore, the fibre mats may be made with admixing of other fibres, which may be organic or inorganic. Even though it is preferred to produce the fibre mats from plant fibres formed by the method according to the invention of economic reasons, it will also be possible to use plant fibres made into long fibres, so-called tow.

Thus it will be possible to use tow from the textile industry stemming from flax as well as hemp and where the tow, for example in hammer mills, is shortened to the desired fibre lengths before forming the fibre mat by the dry-forming process.

The fibres that may be used by the method according to the invention may have different compositions:

- shortened fibres, that are retted or unretted, consisting of cleaned flax and/or hemp fibres admixed with up to 10% shives,
- shortened fibres, that are retted or unretted, primarily as single fibres, consisting of flax and/or hemp fibres admixed shives from flax and/or hemp with up to 90% shives,
- short fibres, that are retted or unretted, primarily as fibre bundles and shives from flax and/or hemp,
- shives separated by cleaning flax and/or hemp, or
- a dust fraction separated by cleaning consisting of very short fibres together with shives.

The fibre quality will depend on the desired properties by the formed final product. By an advantageous method for making fibre mats which are suitable as isolating mats, the plant stems are dried to a water content between 10 and 16%. Then the stems are scutched and shortened in a hammer mill so that the main part of the fibres preferably have a length between 3 and 20 mm, where the fibres will have an average length between 4 and 15 mm. This takes place advantageously by using a rotating riddle. Then the fibres are dry-formed which preferably takes place by using a former head placed above a vacuum box wherebetween there is disposed a former wire on which the fibres are deposited and held by a vacuum. The setting takes place by compacting together with addition of 0 - 5% binder. Alternatively, there may still be used up to 50% binder, if there is especially great requirements to the handiness of the formed fibre mat.

A fibre mat formed by the method according to the invention do not need to be a plane plate or sheet. Thus it will be possible to perform a final treatment simultaneously with the setting or in immediate connection with setting of the inter-fibre bonds.

Thus it will be possible to impart a spatial form to the fibre mat, for example a wave form which makes it suitable as reinforcing fibres in a composite plate, for example a high-strength composite plate or a workable composite plate. Alternatively, the fibre

mat may be shaped to receive the form of a desired packing, for example the form of a box or a cup. Thus a fibre mat, being stable of shape and firm, could be used in making packing products or plant pots. The packing/plant pot may be formed by a pressing operation in immediate connection with the setting step.

The method and the fibre mat according to the invention will be described more closely by means of the following examples.

Example 1.

This example illustrates a method for making a fibre mat of flax for use as isolating mats as a substitute for mineral wool. Straw from flax, both oil and spinning flax as well as hemp, may be used. The best fibres are obtained from spinning flax which is well retted and possibly hemp if this is retted sufficiently. Here is given an example of making fibre mats for isolation on the basis of spinning flax:

The flax stems are laid in swaths and after about 10 days on the field the seed are combine harvested with a usual combine. Hereafter the straw lie in a straw run/swath on the field and is retted. The retting process may be watched by noting a change in colour on the straw. The desired degree of retting has been achieved when the colour on the straw/fibres changes to light grey. It may be necessary to turn the swath in order to ensure a uniform retting.

The retting process is watched closely and daily there is taken samples in order to ascertain how far the retting process in the hand scutched straw is advanced.

When the desired change of colour has appeared, the straw is gathered by pressing into bales, preferably round bales, normally this takes place at a dry content of about 85% in the straw (15% water).

The bales are transported to the factory where they are dried down to 12% water content. After drying, the bale is unrolled/cut up and the flax straw is fed into the hammer mill where the scutching takes place. From the mill the fibre mass, which now consists

of fibres as well as wooden parts/shives, is fed via a cyclone into a rotating riddle whereby the shives together with dust is separated. The now woollen fibre mass has an average length of about 4 - 15 mm. Some fibres, however, are longer. The length of fibres may to a certain degree be adjusted by regulating the riddle on the hammer mill and by regulating the adjustment of the riddle by the subsequent sorting on the rotating riddle. Normally fibres are cleaned down to a content of 5% shives. By a further cleaning there is obtained a comparatively larger loss of fibres.

The cleaned fibre mass is transported via pipes to the mat plant where a dry-forming takes place. This occurs, for example, by using a former head placed above a vacuum box where between there is disposed a former wire on which the fibres are deposited and held by a vacuum. The mat plant is adjusted to forming a fibre mat/mat in the desired height. This is regulated by means of the speed whereby the fibre feeder (bale breaker) is dosed via a transport blower to the former head. At the same time the advancing speed on the wire is regulated.

If a mat for use as isolation of ceilings and walls etc. is desired to be made, the height of the fibre mat is regulated to for example 200 mm with a desired gram weight of for example 3000 g/m^2. For certain isolation purposes there is desired as light a fibre mat as possible, and under these conditions the fibre mat is not compacted.

If the making of a fibre mat is desired, being more compact and possibly of lesser height, this takes place by regulating the degree of compaction of the fibre mat before, after, or during a possible setting which preferably is performed in an oven.

During the process, where the fibres fall out on former wires and are advanced, 2 - 3% binder, for example in the form of a by-component consisting of polyethylene and polypropylene, is added. Setting of the fibre mat takes place by heat treatment in an oven at about 145°C or other temperature depending of binder type, i.e. the fibre mat is led via a former wire through an oven with desired temperature.

During the process (before setting in oven) possible fire-resistant fabrics are added, as for example salts as borax (0 - 15%), boric acid (0 - 15%), aluminium hydroxide (0 - 15%) or others. The salts may fall down into the fibres or be sprayed on the fibres.

After setting of the fibre mat, it is rolled up via a roller and is packed or cut into shape. During this process the fibre mat may be rolled hard together. When unrolling, the fibre mat reaches the same size and volume as before the rolling as the fibre mat puffs up.

The finished fibre mat is soft and supple. Depending on the degree of retting, the colour will be yellowish/light grey to a darker grey. The fibre mat could be manufactured at a cheaper price than the usual needle carded fibre mats. The fibre mat has a heat isolation corresponding to a lambda value of -0.40. The fibre mat repels humidity immediately because of hydrophobic properties, but the fibre mat is still capable of taking up and giving off humidity with the surroundings.

Example 2.

This example illustrates the method for producing a fibre mat on the basis of flax cellulose for use in the tissue industry, as for example absorbing paper or as cover stocks.

The fibres are produced as above in example 1 described before the forming of mats. The degree of retting may be from the quite unrettet to strongly retted fibres. The woollen fibres now cleaned are subjected to pulping. This may take place by boiling in water under pressure or by boiling in an extruder. The pre-treatment is carried through with or without addition of pulping chemicals as for example caustic soda (sodium hydroxide). The treatment in extruder may proceed at a relatively high level of a dry matter, about 10%, but also at a lower percentage of dry matter.

If extrusion treatment is used, impregnation of the fibres takes place simultaneously with the cutting up of the fibre mass. After extrusion treatment, the fibre mass is conveyed into a container and boiled about 1 hour at about 100°C. Subsequently, the pulp is cleaned for remains of sugar and lignin. The fibre mass now consists of a homoge-

nous distribution of fibres in a slurry containing from 0 - 5% impurities primarily stemming from the shives. These may be cleaned off via centricleaning in a hydrocyclone. The pulp may possibly previous to the cleaning in a hydrocyclone be refined in a refiner if fibrillation of the fibres is desired. For example a disc refiner, "wide angle" refiner, or for example a cutter mill.

After pulping, the flax pulp consists of almost pure cellulose with a content of 80 - 95% cellulose. The dry matter yield is between 75 - 90%. The distribution of the fibre length has been measured with Bayer McNett index between 200 - 300, preferably between 240 - 280. The strength in the flax cellulose has been measured in $Nm/m^2/cm^2$ from 100 - 160, or more.

If bleached pulp is desired, 2 % peroxide may be added and there is achieved a blightness of about 75.

The finished pulp is dried and defibrated in a beater mill/hammer mill, if the fibres are desired to be completely defibrated before forming into a fibre mat. The forming takes place as described in example 1, but, depending on the application, there is produced a thinner mat as for example for use as absorbing paper for use in sanitary tissues and the like (about 70 - about 200 g/m^2). A very thin mat (20 g/m^2) can be used as coverstock by admixing about 15% or less hydrophobic binders.

Even without bleaching the pulp, the products are very bright, from light grey to whitish.

Example 3.

This example illustrates a method for making moulded composites on the basis of the fibre mat of hemp or flax.

As a basis for achieving a fibre plate with high strength, it is possible to use comparatively unretted fibres, possibly admixed with shives. The fibre strength in unretted to slightly retted fibres is higher than for strongly retted fibres. Flax as well as hemp will

be suitable raw material because of the high strength of the fibres. The wood parts cleaned off, shives, could also be used for composites corresponding to chip-boards.

The fibre mat is made as above in example 1 described before the forming of a mat. There is produced a fibre mat of desired height and gram weight, for example 300 g/m^2. By the use of comparatively unretted flax or hemp, the fibre mat is very stiff and hard. The shives content may be adjusted according to wish. The higher content, the stiffer mat before moulding.

During the mat making, a so-called plant fibre compatilizer is sprayed on, i.e. a chemical modification with for example isocyanate (about 1 - 2%) in order to ensure the hydrophobic fibres obtain a surface which is compatible with traditional binders like formaldehyde etc. used as binder in the fibre plate. Instead of adding a formaldehyde, EVA (evanylacetate) or natural binders may be a possibility.

Also, the fibres are glued before, under, or immediately after the mat making or immediately after pressing with heat, vacuum, or autoclave/moulding, as in the traditional methods for making of fibre plates and chip-boards.

The moulded composites based on hemp or flax fibres have a strength at level with hard masonite.

If a highly reinforced composite is desired made, there is used a greater part of organic binders as synthetic polymers comprising thermoplastics and thermosetting plastics, for example polypropylene, polyacetate and polyester. About 50% binder is added. The additional binder takes place during the mat making, and the fibre mat is pressed subsequently with high pressure into the desired shapes. The shaping proceeds as described under example 1.

The highly reinforced composites have a strength at a level with glass fibre and are useful as substitution for plastic composites and glass fibre composites.

CLAIMS

1. A method for manufacturing a fibre mat using vegetable fibres, where the fibres are pre-treated, as the plants are harvested by cutting and threshing, where plant stems are retted wholly or partially and thereafter shortened and separated for establishing a fibre mass comprising mainly single fibres with lengths within the desired interval between 0.1 and 30 mm, where drying is possibly performed for providing a desired water content, where the fibres are randomly oriented, as the mat is formed by a dry forming process, and where the mat is fixed, as inter-fibre bonds at least partially are established between the single fibres as these are more or less fibrillated.

2. A method according to claim 1, c h a r a c t e r i s e d in that the pre-treatment comprises a shortening of the fibres to a length between 3 and 20 mm and especially between 4 and 15 mm.

3. A method according to claim 1 or 2, c h a r a c t e r i s e d in that the fibres are retted partially on the field and that they afterwards are imparted a possible further controlled retting in water containing enzymes before the shortening.

4. A method according to any preceding claim, c h a r a c t e r i s e d in that the inter-fibre bonds are established by the application of organic binders, synthetic organic binders or natural binders.

5. A method according to any preceding claim, c h a r a c t e r i s e d in that the fibres are selected among flax and hemp.

6. A method according to any preceding claim, c h a r a c t e r i s e d in that the stems are scutched in a hammer mill and shortened to a desired length, that fibres within a desired length interval are separated by use of a rotating riddle, that the fibre fraction is dry formed into a mat as the fibres are blown into a forming head disposed above a forming wire.

7. A method according to any preceding claim, c h a r a c t e r i s e d in that the formed mat is fixed by addition of between 0 and 50 % binder.

8. A method according to any preceding claim, c h a r a c t e r i s e d in that the formed mat contains between 0 and 10 % shives.

9. A method according to claim 1, c h a r a c t e r i s e d in that shortening and separation of fibres is performed in the dry condition, and that the pre-treatment comprises pulping of the fibres as the fibres are boiled in pure water under pressure or boiled in an extruder, that they are treated chemically, for example by adding base, that they are washed and that they are dried before the formed fibres are dry formed.

10. A fibre mat manufactured by the method according to any preceding claim, c h a r a c t e r i s e d in that it has the character of a non-woven mat and is made with thickness' between 2 and 300 mm and with gram weights between 30 and 8000 g/m^2.

11. Use of a fibre mat manufactured by a method according to any of the claims 1 - 9 as isolating mat, as absorbing fibre mat, as element in a moulded composite product or as element in a strongly reinforced composite product.